

What is claimed is:

- 1        1. A method for forming a self-aligned contact hole comprising:
  - 2            (a) forming a plurality of conductive structures on a semiconductor substrate, each conductive structure including a conductive film pattern having an upper and side surfaces and a protection pattern formed on the upper and surfaces of the conductive film pattern;
  - 6            (b) forming a first insulation film to fill a space between adjacent conductive structures;
  - 8            (c) successively etching upper portions of the first insulation film and the protection patterns until each of the protection patterns has a level upper surface that is exposed;
  - 11          (d) forming a second insulation film on the resultant structure on the semiconductor substrate; and
  - 13          (e) selectively etching portions of the second insulation film and the first insulation film using a photolithography process to form the self-aligned contact hole exposing a portion of the semiconductor substrate between adjacent conductive structures.

1           2.     The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the plurality of conductive film patterns comprise  
3        composite film patterns including polysilicon film patterns and metal silicide  
4        film patterns.

1           3.     The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the first insulation film comprises an oxide having a good  
3        reflow-ability.

1           4.     The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the first insulation film is formed of a material selected  
3        from the group consisting of boro-phosphor silicate glass (BPSG), undoped  
4        silicate glass (USG) or spin-on glass (SOG).

1           5.     The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the second insulation film is formed of a material  
3        comprising atoms having tighter bonds than the atoms of the first insulation  
4        film.

1           6. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the second insulation film comprises an oxide that is  
3        etched by a rinsing chemical more slowly than the first insulation film.

1           7. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the second insulation film is formed by a high density  
3        plasma chemical vapor deposition process or a plasma-enhanced chemical  
4        vapor deposition process.

1           8. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the first insulation film and the second insulation film are  
3        formed using different materials.

1           9. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the first insulation film and the second insulation film are  
3        formed through different processes.

1           10. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the first insulation film is formed of boro-phosphor silicate  
3        glass (BPSG) and the second insulation film is formed of BPSG including  
4        boron (B) and phosphorus (P) ion concentrations lower than the  
5        concentrations of boron and phosphorous in the first insulation film.

1           11. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the protection pattern comprises a material having an  
3        etching selectivity with respect to the first insulation film and the second  
4        insulation film.

1           12. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the protection pattern comprises silicon nitride.

1           13. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein each of the plurality of conductive structures has a  
3        thickness that is greater than approximately 4,000 Å.

1           14. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein a space between adjacent conductive structures is less  
3        than approximately 1,500 Å.

1           15. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein a width of each of the conductive film patterns is less than  
3        approximately 2,500 Å.

1           16. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein a width of the exposed upper surface of the protection  
3        pattern is at least equal to or wider than a width of an upper surface of the  
4        conductive film patterns.

1           17. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the successive etching is performed using a dry etching  
3        process or a chemical-mechanical polishing process.

1           18. The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein during the successive etching, the first insulation film is  
3        etched slower than the protection pattern so that a portion of the first  
4        insulation film filled between adjacent conductive structures protrudes from  
5        the upper surface of the conductive structures.

1           19. The method for forming a self-aligned contact hole as claimed  
2        in claim 18, wherein during the successive etching, an etching ratio between  
3        the first insulation film and the protection pattern is about 1:1 - 1:1.5.

1           20. The method for forming a self-aligned contact hole as claimed  
2        in claim 14, wherein the successive etching is performed by a chemical-  
3        mechanical polishing process using a slurry to etch the first insulation film  
4        slower than the protection pattern.

1           21. The method for forming a self-aligned contact hole as claimed  
2        in claim 14, wherein the successive etching is performed by a dry etching

3       process using an etching gas for etching the first insulation film slower than  
4       the protection pattern.

1           22.     The method for forming a self-aligned contact hole as claimed  
2       in claim 1, further comprising rinsing the semiconductor substrate with a  
3       rinsing chemical to remove polymers generated during the etching  
4       performed in (e).

1           23.     The method for forming a self-aligned contact hole as claimed  
2       in claim 1, wherein the photolithography process in the selectively etching of  
3       the first and second insulation films is performed using a mask pattern  
4       including an open region covering a region between the conductive  
5       structures and an upper surface portion of the level upper surface of the  
6       protection pattern.

1           24.     The method for forming a self-aligned contact hole as claimed  
2       in claim 1, wherein the selective etching of the first and second insulation  
3       films is performed using an anisotropic etching.

1           25. The method for forming a self-aligned contact hole as claimed  
2       in claim 24, wherein the anisotropic etching is performed using a mixture of  
3       CHF<sub>3</sub>, CF<sub>4</sub> and Ar.

1           26. The method for forming a self-aligned contact hole as claimed  
2       in claim 1, wherein forming a plurality of conductive patterns comprises:  
3           forming a conductive film and a first nitride film on the semiconductor  
4       substrate;  
5           forming the plurality of conductive structures, each including the  
6       conductive film pattern and the protection pattern by etching portions of the  
7       conductive film and the first nitride film to expose portions of the  
8       semiconductor substrate between adjacent conductive structures;  
9           forming a second nitride film having a uniform thickness on the  
10      plurality of conductive structures and on the exposed portions of the  
11      semiconductor substrate; and  
12           forming the protection film patterns including the first and second  
13      nitride films on upper and side surfaces of the plurality of conductive film

14        patterns by anisotropically etching the second nitride film to remove a portion  
15        of the second nitride film formed on the semiconductor substrate.

1            27.      The method for forming a self-aligned contact hole as claimed  
2        in claim 1, further comprising forming a nitride liner on the plurality of  
3        conductive structures and on the semiconductor substrate after forming the  
4        plurality of conductive structures.

1            28.      The method for forming a self-aligned contact hole as claimed  
2        in claim 1, wherein the successive etching is performed until more than  
3        approximately 500 Å of the protection pattern is etched.

1            29.      The method for forming a self-aligned contact hole as claimed  
2        in claim 1, further comprising:  
3            forming a conductive material in the self-aligned contact hole to form  
4        a contact.